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(71)Applicant : TOYOTA MOTOR CORP

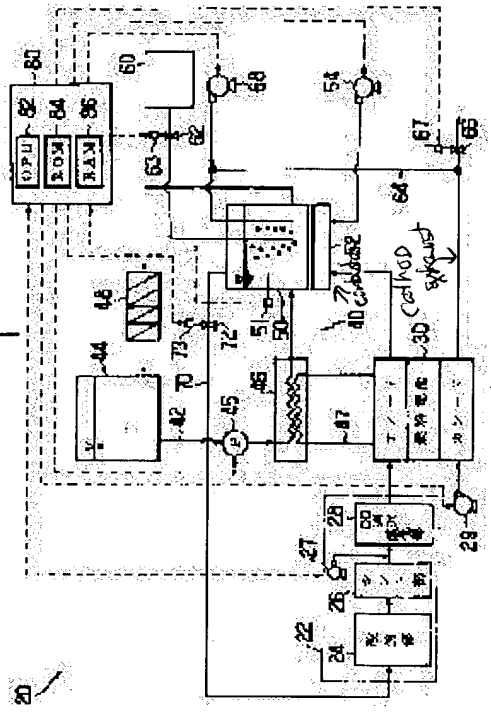
(72)Inventor : AOYAMA SATOSHI

(54) FUEL CELL SYSTEM

(57)Abstract:

PROBLEM TO BE SOLVED: To increase a ratio of a water vapor contained in a raw gas including a hydrocarbon fuel, oxygen and the water vapor and to supply the amount of water vapor meeting the hydrocarbon fuel to a reformer.

SOLUTION: In this system, a gas mixed with an exhaust gas from a cathode and the air and a methane from a methane tank 60 are brought into contact with a hot water of a humidifier 50 to be moisturized for supplying a reformer 22. An exhaust gas from an anode is fired by a combustor 52 to heat the hot water of the humidifier 50 and the pressure of the humidifier 50 is adjusted by an adjustment valve 72. A saturated water vapor pressure in a raw gas is determined by temperature or pressure and the ratio of the water vapor in the raw gas in the saturated water vapor pressure to the methane is determined by a partial pressure of the methane in the raw gas. Thus the raw gas is included with the exhaust gas of the cathode to adjust the partial pressure of the methane and adjusting the temperature and pressure of the humidifier 50 adjusts the saturated water vapor pressure. Consequently, the ratio of the water vapor in the raw gas to the methane.



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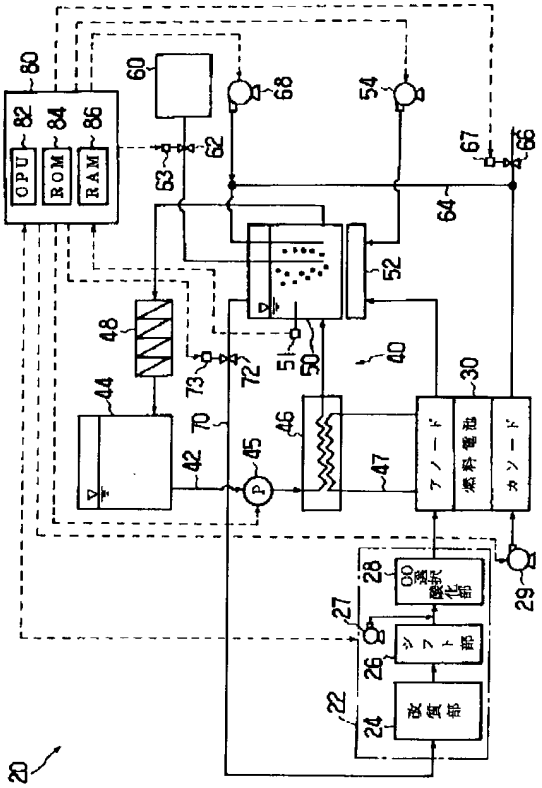
Drawing selection Representative drawing



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the fuel cell system which has the fuel cell generated in response to supply with the refining machine which generates the fuel gas which contains hydrogen in response to supply of the material gas containing the fuel, the steam, and oxygen of a hydrocarbon system, and the oxidation gas containing oxygen and said fuel gas in detail about a fuel cell system.
[0002]
[Description of the Prior Art] Conventionally, what supplies the material gas containing the air humidified by contact in the warmed water as this kind of a fuel cell system and the fuel of a hydrocarbon system to a refining machine is proposed (for example, JP,10-330101,A etc.). In this system, the mixed gas of the fuel of a hydrocarbon system, a steam, and air was supplied to the refining machine, the partial oxidation reaction and the steam-reforming reaction of the fuel of a hydrocarbon system by the oxygen in the air of the fuel of a hydrocarbon system were made to perform, hydeogen-rich gas was generated, this hydeogen-rich gas and air were supplied to the fuel cell, and power has been obtained. The steam in the mixed gas supplied to a refining machine is supplied by contacting air in the warm water used for cooling of a fuel cell, and humidifying. The warm water used for cooling of a fuel cell is used for raising the partial pressure of the steam contained in air, and supplying more steams to mixed gas. Moreover, what this official report is contacted in the warm water used for cooling of a fuel cell, and humidifies the gaseous mixture of air and the fuel of a hydrocarbon system in it is indicated. In addition, the partial oxidation reaction of the methane at the time of using methane as a fuel of a hydrocarbon system turns into a reaction of a degree type (1), and the steam-reforming reaction of methane turns into a reaction of a degree type (2). In addition, the carbon monoxide generated by the formula (1) and the formula (2) produces hydrogen by the water gas shift reaction further shown in a steam and a degree type (3).
[0003]
$CH_4+(1/2)\,O_2 \rightarrow 2H_2+CO+35.7kJ$ (1)
$CH_4+H_2O \rightarrow 3H_2+CO-206.2kJ$ (2)
$CO+H_2\,O \rightarrow H_2+CO_2+41.2kJ$ (3)
[0004]
[Problem(s) to be Solved by the Invention] However, there was a problem that steams enough in such a conventional fuel cell system for the gas supplied to a refining machine could not be included. Since the operating temperature of a fuel cell is about 80 degrees C in the case of a polymer electrolyte fuel cell, the warm water used for cooling of a fuel cell can humidify the air humidified only to the saturated water vapor pressure in 80 degrees C. In the saturated water vapor pressure in these 80 degrees C, when methane is assumed as a fuel of a hydrocarbon system, the mole ratio (mol of a steam mol of a number/methane number) to the methane of a steam becomes about 1.5. Although two mols or more of steams are needed to one-mol methane in order two mols are required for a steam and to raise the invert ratio (conversion) of methane to one-mol methane, as shown in an above-mentioned formula (2) and an

above-mentioned formula (3), at 80 degrees C, it will become about 1.5 and the invert ratio of methane will be reduced. Moreover, such lack of a steam also produces the problem which carbon is deposited inside a refining machine, elevated-temperature-izes reaction temperature in a refining machine, or raises concentration of the carbon monoxide in the hydeogen-rich gas obtained.
[0005] The fuel cell system of this invention sets to one of the objects to make high the mixing ratio of the steam contained in the material gas supplied to a refining machine. Moreover, the fuel cell system of this invention sets to supply the steam corresponding to the fuel of a hydrocarbon system to a refining machine to one of the objects.
[0006]
[The means for solving a technical problem, and its operation and effectiveness] The fuel cell system of this invention took the following means, in order to attain a part of above-mentioned object [at least].
[0007] The refining machine which generates the fuel gas which contains hydrogen in response to supply of the material gas with which the 1st fuel cell system of this invention contains the fuel, the steam, and oxygen of a hydrocarbon system, the water which is the fuel cell system which has the fuel cell generated in response to supply with the oxidation gas containing oxygen, and said fuel gas, and warms water using the heat which said fuel cell produces with a generation of electrical energy -- warming -- with a means Let it be a summary to equip this material gas with a steam supply means to supply a steam, and a heating means by which the water of this steam supply means can be heated by contacting some [at least] gases which constitute said material gas in the warmed this water, and humidifying them.
[0008] In the 1st fuel cell system of this this invention, since a heating means heats the water of a steam supply means, the steam partial pressure of the gas which contacts water and is humidified can be made high. Consequently, the mixing ratio of the steam contained in material gas can be made high.
[0009] In the 1st fuel cell system of this invention, said gas shall be gas containing the fuel of said hydrocarbon system.
[0010] Moreover, in the 1st fuel cell system of this invention, said gas shall be gas containing the oxygen content gas containing oxygen, and said gas shall be gas containing the fuel of said hydrocarbon system, and the oxidation gas containing oxygen. In the 1st fuel cell system of this invention of this mode, said oxygen content gas shall be gas including air. In the 1st fuel cell system of this invention of the same mode, said oxygen content gas shall be gas containing the exhaust gas of said oxidation gas discharged from said fuel cell. Since the rate of nitrogen to oxygen is high, the exhaust gas of oxidization gas can include many steams in material gas by making [many] volume of the gas humidified. That is, although exhaust gas does not contribute to the reaction in a refining machine, since it contains many nitrogen which functions as a gas which carries a steam, it can make [many] the steam which makes [many] volume of material gas and is contained in material gas, without changing the ratio of oxygen and the fuel of a hydrocarbon system by including exhaust gas in material gas.
[0011] Moreover, said oxygen content gas shall be equipped with a rate accommodation means adjust the rate of the exhaust gas of said oxidation gas and air which are gas including the exhaust gas and air of said oxidation gas discharged from said fuel cell, and are included in said oxygen content gas, in the 1st fuel cell system of this invention of the mode which humidifies the gas containing oxygen content gas. If it carries out like this, the rate of the oxygen in oxygen content gas and nitrogen can be adjusted. Consequently, the rate of the steam contained in material gas can also be adjusted.
[0012] Said heating means shall be [in / including each / these / mode / the 1st fuel cell system of this invention] a means to heat the water of said steam supply means, by burning at least the exhaust gas of said fuel gas discharged from said fuel cell as some fuels. If it carries out like this, the utilization effectiveness of fuel gas can be raised.
[0013] Moreover, in the 1st fuel cell system of this invention, it shall have a temperature detection means to detect the temperature of the water of said steam supply means, and the heating control means which controls heating by said heating means based on the this detected temperature. If it carries out like this, the amount of the steam contained in the gas humidified by controlling to the temperature of the water of a steam supply means is controllable.

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[0014] While supplying the exhaust gas of fuel gas to a heating means, said heating means shall be equipped with the air supply means which can supply air in the 1st fuel cell system of this invention of a mode equipped with a heating control means, and said heating control means shall be a means control said air supply means to adjust the air content supplied to said heating means based on the temperature detected by said temperature detection means. If it carries out like this, the temperature of combustion gas can be adjusted by adjusting the air content supplied to a heating means. Consequently, the temperature of the water of a steam supply means can be adjusted and the amount of the steam contained in the gas humidified can be adjusted.
[0015] The refining machine which generates the fuel gas which contains hydrogen in response to supply of the material gas with which the 2nd fuel cell system of this invention contains the fuel, the steam, and oxygen of a hydrocarbon system, the water which is the fuel cell system which has the fuel cell generated in response to supply with the oxidation gas containing oxygen, and said fuel gas, and warms water using the heat which said fuel cell produces with a generation of electrical energy -- warming -- with a means the gas containing the non-reacting gas content gas which contains the non-reacting gas which does not contribute to the reaction in said refining machine by the ratio higher than the ratio to the oxygen of the nitrogen in air -- said water -- warming -- with a steam supply means to supply a steam to this gas, by making the water warmed by the means contact and humidifying Let it be a summary to have the mixing means which mixes with the gas containing said non-reacting gas content gas, and said fuel, and is made into said material gas.
[0016] In the 2nd fuel cell system of this this invention, the gas containing the non-reacting gas content gas which contains the non-reacting gas which does not contribute to the reaction in a refining machine by the ratio higher than the ratio to the oxygen of the nitrogen in air is humidified, and it mixes with this gas and the fuel of a hydrocarbon system, and considers as material gas. According to the 2nd fuel cell system of this invention, the ratio of the steam to the fuel of a hydrocarbon system can be made high by making high the ratio of the non-reacting gas in material gas.
[0017] In the 2nd fuel cell system of such this invention, said steam supply means shall be a means which serves as said mixing means. If it carries out like this, since the fuel of a hydrocarbon system will also function as a carrier which carries a steam, the ratio of the steam in material gas can be made higher.
[0018] Moreover, in the 2nd fuel cell system of this invention, said non-reacting gas content gas shall be exhaust gas of said oxidation gas discharged from said fuel cell. The ratio of the nitrogen as a non-reacting gas which the exhaust gas of oxidation gas does not contribute to the reaction in a refining machine since oxygen is consumed with the fuel cell is high. If it carries out like this, it is not necessary to store non-reacting gas content gas.
[0019] Or in the 2nd fuel cell system of this invention, said non-reacting gas content gas shall be the mixed gas of the exhaust gas of said oxidation gas and air which are discharged from said fuel cell. this voice -- the mixing ratio which adjusts the mixing ratio of the exhaust gas of said oxidation gas and air in said mixed gas in the 2nd fuel cell system of this invention [like] -- it shall have an accommodation means If it carries out like this, the ratio of the oxygen in material gas and nitrogen can be adjusted, consequently the ratio of the steam in material gas can be adjusted.
[0020] Moreover, in the 2nd fuel cell system of this invention, it shall have a heat-of-hydration means to heat the water of said steam supply means. If it carries out like this, saturated water vapor pressure of the gas humidified can be made high, and the ratio of the steam in material gas can be made high as a result.

[0021] It shall have a ****** means to adjust the pressure of said gas which contacts the water of said steam supply means in the 1st of this invention, or the 2nd fuel cell system including each [these] mode. If it carries out like this, a water vapor content can be adjusted by adjusting the pressure of the gas humidified.
[0022] Moreover, in the 1st of this invention, or the 2nd fuel cell system, said steam supply means shall be a means to constitute a part of cooling system which cools said fuel cell. If it carries out like this, it is not necessary to have two or more water systems, and a system can be used as a compact. In the 1st of

this invention of this mode, or the 2nd fuel cell system, said cooling system shall be a means which carries out said fuel cell and heat exchange in the preceding paragraph of said steam supply means. moreover, the same voice -- said cooling system shall be equipped with a cooling means to cool water in the latter part of said steam supply means, in the 1st of this invention [like], or the 2nd fuel cell system [0023]

[Embodiment of the Invention] Next, the gestalt of operation of this invention is explained using an example. Drawing 1 is the block diagram showing the outline of the configuration of the fuel cell system 20 which is one example of this invention. So that it may illustrate the fuel cell system 20 of an example the methane as a fuel of a hydrocarbon system -- steam reforming -- hydrogen -- with the refining machine 22 reformed to rich fuel gas The fuel cell 30 generated in response to supply with the air as fuel gas and oxidation gas containing oxygen, It has the humidifier 50 which humidifies the cooling system 40 which cools a fuel cell 30, and the gas containing the methane which it is included in this cooling system 40, and is supplied to the refining machine 22, or oxygen, and the electronic control unit 80 which controls the fuel cell system 20 whole.

[0024] The refining section 24 which performs the partial oxidation reaction of the formula (1) which mainly mentioned the refining machine 22 above to the material gas containing methane, oxygen, and a steam, and the steam-reforming reaction of a formula (2), It has the shift section 26 which uses as hydrogen and a carbon dioxide the carbon monoxide mainly generated by the refining section 24 by the water gas shift reaction of a formula (3), and CO selective oxidation section 28 which oxidizes selectively the carbon monoxide contained in the fuel gas obtained in this way. In addition, the refining machine 22 is equipped also with the blower 27 which introduces air into fuel gas for the selective oxidation of the carbon monoxide in CO selective oxidation section 28.

[0025] A fuel cell 30 is a polymer electrolyte fuel cell constituted by carrying out two or more laminatings of the cell 31. The outline configuration of the cell 31 which constitutes a fuel cell 30 in drawing 2 is shown. The electrolyte membrane 32 which is the membrane of proton conductivity in which the cell 31 was formed with polymeric materials, such as fluorine system resin, so that it may illustrate, The anode 33 and cathode 34 as a gas diffusion electrode which are formed of the carbon cross which the catalyst of the alloy which consists of platinum or platinum, and other metals scoured, and was loaded with it, pinch an electrolyte membrane 32 in respect of the catalyst having scoured and having been put, and constitute sandwich structure, It is constituted by two separators 35 which make the septum between the cells 31 which adjoin while forming the passage 36 and 37 of fuel gas or oxidation gas with an anode 33 and a cathode 34, inserting this sandwich structure from both sides.

[0026] The cooling system 40 is equipped with the circulation duct 42 of cooling water, and the heat exchanger 46 for carrying out heat exchange to the water tank 44 which supplies the insufficiency of cooling water, the circulating pump 45 which makes the circulation duct 42 circulate through cooling water, and a fuel cell 30 in this circulation duct 42, the above-mentioned humidifier 50, and the radiator 48 that cools cooling water by the open air are connected to this order. A part of circulation duct 47 which forms a circulation duct by making a fuel cell 30 into the part is introduced into the heat exchanger 46, and the cooling water which circulates through the circulation duct 42, and the cooling medium (for example, water) which circulates through the circulation duct 47 carry out heat exchange. Therefore, the cooling water which circulates through the circulation duct 42 will be warmed with this radiator 48 to about 80 degrees C which is the operating temperature of a fuel cell 30, and will flow into a humidifier 50.

[0027] The humidifier 50 is formed as a tank of warm water, and it functions as a rapid mixing chamber which mixes with these humidified gas while it humidifies the methane from the methane tank 60 which stores mixed gas and methane of air from the exhaust gas and the blower 68 from a cathode 34 of the fuel cell 30 supplied through the cathode exhaust tubing 64. The combustor 52 for heating the warm water of that interior is put side by side in the humidifier 50, and the air from the exhaust gas and the blower 54 from an anode 33 of a fuel cell 30 is introduced into this combustor 52. The material gas with which it was humidified and mixed with the humidifier 50 is supplied to the refining machine 22 through the material gas supply pipe 70. The pressure regulating valve 72 is attached near the humidifier

50 outlet of this material gas supply pipe 70, and the pressure inside a humidifier 50 can be adjusted now. In addition, the solenoid valve 62 is attached in the supply pipe of the methane from the methane tank 60, and it has come to be able to perform accommodation of the amount of supply. Moreover, the branch pipe is attached in the cathode exhaust tubing 64, and a part or all of exhaust gas of a cathode 34 is opened by atmospheric air by carrying out Kaisei of the solenoid valve 66 attached in the branch pipe.

[0028] The electronic control unit 80 is constituted considering CPU82 as a one-chip microprocessor constituted as a core, and is equipped with ROM84 which memorized the processing program, RAM86 which memorizes data temporarily, and input/output port (not shown). The water temperature of the humidifier 50 interior from the temperature sensor 51 attached in the various signals and humidifiers 50 of each part of the refining machine 22, such as temperature, etc. is inputted into this electronic control unit 80 through input port. Moreover, from the electronic control unit 80, the driving signal to the actuator 73 for driving the driving signal to the actuators 63 and 67 for driving the driving signal to each part of the refining machine 22, the driving signal to blowers 29, 54, and 68, and solenoid valves 62 and 66 and a pressure regulating valve 72 etc. is outputted through the output port.

[0029] Next, actuation of the fuel cell system 20 of the example constituted in this way, especially actuation of humidification of the material gas supplied to the refining machine 22 are explained. The amount per unit time amount of the methane in the material gas supplied to the refining machine 22 (the number of mols) is defined by setting out of the hydrogen concentration in the exhaust gas discharged from the magnitude and the anode 33 of a fuel cell 30 etc. The ratio of the oxygen in material gas is set to 0.4 thru/or about 0.6 by the mole ratio [O2/CH4] to the amount of such methane. The reaction of the formula (1) thru/or formula (3) at which this mole ratio [O2/CH4] mentioned this above by a little less than 0.5 realizes [the income and outgo of chemical equilibrium top heat of reaction] generation of heat from autothermal one used as a value 0, and a mole ratio [O2/CH4] is based on the refining section 24 serving as a heating element as a whole or more by 0.5. In the example, it is adjusted so that the amount of the oxygen in the mixed gas of the exhaust gas from a cathode 34 and air may become about 0.5 by the mole ratio [O2/CH4] to the amount of the methane from the methane tank 60. In addition, the rate of the exhaust gas from a cathode 34 and air is set up also in consideration of the ratio of the steam in material gas.

[0030] The ratio of the steam in material gas becomes settled with temperature and a pressure. The relation of the amount of a steam, the temperature, and the pressure to carrier gas is shown in drawing 3 . A water vapor content decreases, so that it may illustrate and fixed, then a pressure become high about temperature, and a water vapor content increases a pressure, so that fixed, then temperature become high. The percentage of the oxygen of the exhaust gas from 90 degrees C and a cathode 34 and nitrogen with two atmospheric pressures now 1:8 (when a cathode air utilization factor is made into 50%), [the pressure of a humidifier 50] [temperature] Considering the case where a mole ratio [as opposed to the methane of the oxygen in 1:1 and material gas in the mixing ratio of the oxygen in the exhaust gas from the cathode 34 in mixed gas and the oxygen in air] [O2/CH4] is 0.5 The mole ratio to the carrier gas of the graph of drawing 3 to a steam is about 55%, and since carrier gas serves as methane and the sum of mixed gas, it becomes 4.5 mols per equivalent of methane. Therefore, if carrier gas is humidified with saturated water vapor pressure, the mole ratio [H2 O/CH4] to the methane of the steam in material gas is set to 2.475.

[0031] The mixed gas of the exhaust gas from a cathode 34 and air is explained to a slight degree. As shown in the graph of drawing 3 , if carrier gas increases, since a water vapor content will increase, if the amount of material gas can be increased without changing the ratio of the methane of material gas and oxygen which are supplied to the refining machine 22, it can make high the mole ratio to the methane of the steam in material gas. The exhaust gas from a cathode 34 is the air after oxygen was consumed by the fuel cell 30, and is the reaction (the nitrogen as a gas which is not contributed to an above-mentioned formula (1) thru/or an above-mentioned formula (3) has increased in number to the rate of air.) of the refining machine 22. Therefore, by including this exhaust gas in material gas, the amount of material gas can be increased, without changing the ratio of the methane of material gas, and

oxygen, consequently the mole ratio to the methane of the steam in material gas can be made high. For example, if carrier gas becomes 5.5 mols per equivalent of methane and carrier gas is humidified with saturated water vapor pressure when the mixed gas of an above-mentioned example is made only into exhaust gas from a cathode 34, the mole ratio [H2 O/CH4] to the methane of the steam in material gas is set to 3.025. Moreover, on the same conditions, in the temperature of a humidifier 50, the mole ratio to the carrier gas of a steam becomes about 30%, and the mole ratio [H2 O/CH4] to the methane of the steam in material gas is set to 1.65 from 80 degrees C, then the graph of drawing 3 . Furthermore, 1.5 atmospheric pressures, then the mole ratio to the carrier gas of a steam become about 45% about the pressure of a humidifier 50, and the mole ratio [H2 O/CH4] to the methane of the steam in material gas is set to 2.475. Thus, by adjusting the mixing ratio of the exhaust gas from the cathode 34 in mixed gas, and air, the amount of material gas per equivalent of methane can be adjusted, consequently the ratio to the methane of the steam in material gas can be adjusted.

[0032] Since explanation is easy, it shall operate so that a mole ratio [as opposed to / pressure / of the humidifier 50 which mentioned above the fuel cell system 20 of an example / temperature / percentage / of the oxygen of the exhaust gas from 90 degrees C and a cathode 34 and nitrogen / the methane of the oxygen in 1:1 and material gas in the mixing ratio of the exhaust gas from the cathode 34 in 1:8 and mixed gas and air] [O2/CH4] may be set to 0.5 with two atmospheric pressures. To the flow rate of the methane from the methane tank 60 supplied to a humidifier 50, a mixing ratio should just adjust operation of the blower 29 which supplies the air as oxidization gas to the cathode 34 of a fuel cell 30, operation of the blower 68 which introduces air into exhaust gas from a cathode 34, and the opening of a solenoid valve 66 so that the flow rate of the mixed gas of the exhaust gas from the cathode 34 of 1:1 and air may be set to 3.5 by the ratio.

[0033] Temperature of the warm water of a humidifier 50 is performed by the temperature control manipulation routine illustrated to drawing 4 . This routine is repeatedly performed for every (every [for example,] 5 seconds) predetermined time, after operation of the fuel cell system 20 of an example is started and a system is operated steadily. If this routine is performed, CPU82 of an electronic control unit 80 will perform processing which reads the temperature T of the warm water of the humidifier 50 first detected by the temperature sensor 51 (step S100). Then, the read temperature T is measured with a threshold Tr (step S102). Here, a threshold Tr is set up as temperature [a little] higher than the laying temperature and this temperature of warm water of a humidifier 50.

[0034] The predetermined value Q1 is set as the air content Qa supplied to a combustor 52 from a blower 54 when the temperature T of the warm water of a humidifier 50 is under the threshold Tr (step S104), and when temperature T is beyond the threshold Tr, a value only with bigger deltaQ than the predetermined value Q1 is set as the air content Qa supplied to a combustor 52 from a blower 54 (step S106). Here, the predetermined value Q1 is set up as a big value a little from the value of the air content which serves as theoretical air fuel ratio to the hydrogen of the exhaust gas of the anode 33 supplied to a combustor 52, or this, and becomes settled by the property of a fuel cell 30, specification setting out of the fuel cell system 20 of an example, etc. And a blower 54 is driven so that the set-up air content Qa may be supplied to a combustor 52 (step S108), and this routine is ended. It is based on the temperature of combustion gas becoming low that temperature of the warm water of a humidifier 50 can be adjusted by this processing, when the air content over the amount of the fuel supplied is larger than theoretical air fuel ratio. The temperature T of the warm water of a humidifier 50 namely, when higher than the set point The temperature of the warm water of a humidifier 50 by making [more] the air content supplied to a combustor 52 than theoretical air fuel ratio, and making temperature of combustion gas low Lowering, Conversely, the temperature T of the warm water of a humidifier 50 raises the temperature of the warm water of a humidifier 50 by carrying out near of the air content supplied to a combustor 52 to theoretical air fuel ratio, and making temperature of combustion gas high, when lower than the set point.

[0035] As explained above, according to the fuel cell system 20 of an example, the ratio of the steam to methane can supply good material gas to the refining machine 22 by adjusting the flow rate of the mixed gas supplied to a humidifier 50, percentage and the pressure of a humidifier 50, and the temperature of

the warm water of a humidifier 50. Namely, according to the fuel cell system 20 of an example, the mole ratio to the methane of the steam in material gas can be adjusted by adjusting the temperature of the warm water of a humidifier 50 with a combustor 52. The mole ratio to the methane of the steam in material gas can be adjusted by adjusting the pressure of a humidifier 50 with a pressure regulating valve 72. By introducing the exhaust gas of a cathode 34 into material gas, the mole ratio to the methane of the steam in material gas can be adjusted, consequently the ratio of the steam to methane can supply good material gas to the refining machine 22.

[0036] Moreover, according to the fuel cell system 20 of an example, since the humidifier 50 was constituted as some cooling systems 40 of a fuel cell 30, the thermal efficiency as the whole can be raised. And since it is not necessary to have two or more water systems, a system can be made compact.

[0037] Furthermore, according to the fuel cell system 20 of an example, since the exhaust gas of an anode 33 is used as a fuel of a combustor 52, the energy efficiency as the whole system can be raised.

[0038] Although the methane from the exhaust gas from a cathode 34, and the mixed gas and the methane tank 60 of air shall be humidified with a humidifier 50 in the fuel cell system 20 of an example Are good also as that with which it mixes with the mixed gas humidified after humidifying the exhaust gas from a cathode 34, and the mixed gas of air with a humidifier 50, and methane. Conversely, it is good also as that with which it mixes with the methane humidified after humidifying the methane from the methane tank 60 with a humidifier 50, and the exhaust gas from a cathode 34 and air. Moreover, after mixing with the methane from the exhaust gas from a cathode 34, and the mixed gas and the methane tank 60 of air, it is good also as what is humidified with a humidifier 50.

[0039] Although it was made to contain in the material gas which humidifies the exhaust gas from a cathode 34 and is supplied to the refining machine 22 in the fuel cell system 20 of an example, it is good also as what does not use the exhaust gas from a cathode 34.

[0040] Although operation of a blower 68 was set up in the fuel cell system 20 of an example so that the exhaust gas and air from a cathode 34 might become a predetermined rate The flowmeter of the oxygen sensor which detects the oxygen density contained in the mixed gas of the exhaust gas from a cathode 34 and air, or mixed gas is attached. It is good also as what carries out feedback control of the amount of oxygen in the mixed gas supplied to per unit time amount based on the value detected by this oxygen sensor, or the value of a flow meter by operation of a blower 68. If it carries out like this, it can consider as the thing of a request of the ratio of the oxygen in material gas, and methane more certainly.

[0041] Although it has the combustor 52 which heats the warm water of a humidifier 50 in the fuel cell system 20 of an example, when the ratio of the steam to the methane in material gas is enough by using the exhaust gas from a cathode 34, it is good also as a configuration which is not equipped with a combustor 52. Moreover, although the exhaust gas from an anode 33 was supplied to the combustor 52 and this was made into the fuel in the fuel cell system 20 of an example, it is good also as what supplies methane from the methane tank 60, or good also as what supplies the methane from the methane tank 60 with the exhaust gas from an anode 33. Furthermore, although it has the combustor 52 which burns a fuel and obtains heat in the fuel cell system 20 of an example, it is good also as a thing equipped with the electric heater which replaces with a combustor 52 and obtains heat in response to supply of power.

[0042] Although the temperature of the warm water of a humidifier 50 shall be controlled by the change in the air content supplied to a combustor 52 by the fuel cell system 20 of an example, it is good also as what controls the temperature of the warm water of a humidifier 50 by fluctuating the flow rate of the cooling water which circulates through the circulation duct 42 of a cooling system 40. What is necessary is just to carry out feedback control of the engine speed of a circulating pump 45 so that it may become the temperature which the temperature detected by the temperature sensor 51 specifically set up.

[0043] Although the pressure regulating valve 72 was attached in the material gas supply pipe 70 in the fuel cell system 20 of an example so that the pressure inside a humidifier 50 might become fixed by the predetermined pressure, it is good also as what carries out feedback control of the opening of a pressure regulating valve 72 based on the value detected by installation and this pressure sensor in the pressure sensor which detects the pressure inside a humidifier 50 further. If it carries out like this, the pressure inside a humidifier 50 can be more certainly kept constant. Furthermore, the pressure the thing which

can set up the target preassure force inside a humidifier 50, then inside a humidifier 50 can be made into a desired pressure. When carrying out like this and things other than methane are used as a fuel as a fuel of a hydrocarbon system, optimal setting pressure can be carried out to the fuel.

[0044] Although considered as the configuration which incorporated the humidifier 50 to some cooling systems 40 of a fuel cell 30 in the fuel cell system 20 of an example, it is good also as what constitutes a humidifier 50 apart from the cooling system of a fuel cell 30.

[0045] Although methane was used as a fuel of a hydrocarbon system in the fuel cell system 20 of an example, other saturated hydrocarbon and unsaturated hydrocarbon may be used and it is good also as a thing using various fuels of a hydrocarbon system, such as alcohol, the ether, etc., such as a methanol.

[0046] As mentioned above, although the gestalt of operation of this invention was explained using the example, as for this invention, it is needless to say that it can carry out with the gestalt which becomes various within limits which are not limited to such an example at all and do not deviate from the summary of this invention.

[Translation done.]